(19) Eur päisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 334 955**
A1

(12) # EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(21) Application number: 87902781.1

(22) Date of filing: 12.05.87

(51) Int. Cl.³: B 60 B 21/10
B 60 C 15/02

Data of the international application taken as a basis:

(86) International application number:
PCT/JP87/00299

(87) International publication number:
WO87/06889 (19.11.87 87/25)

(30) Priority: 15.05.86 JP 112181/86

(43) Date of publication of application:
04.10.89 Bulletin 89/40

(84) Designated Contracting States:
DE FR GB

(71) Applicant: SUMITOMO RUBBER INDUSTRIES LIMITED
No. 1-1, Tsutsui-cho 1-chome
Chuo-ku Kobe-shi Hyogo 651(JP)

(72) Inventor: NOMA, Hiroyuki
16-3, Suzurandai Kita-machi 3-chome
Kita-ku, Kobe-shi Hyogo 651-11(JP)

(74) Representative: Stewart, Charles Geoffrey
SP TYRES UK LIMITED Tyre Technical Division
Fort Dunlop Erdington Birmingham B24 9QT(GB)

(54) **WHEEL RIM AND ASSEMBLY OF WHEEL RIM AND TIRE.**

(57) Rim equally available for a safety tire and an ordinary tire, and assembly of said rim and aforesaid tires; which enables a safe running when the inside pressure of a tire is low or at an abrupt cornering and application not only to a safety tire but also to an ordinary tire. The wheel rim and the assembly made of said rim and a tubeless tire comprise a ring-shaped groove (3) extending in a circumferential direction and formed at the outside of and in the axial direction of a well (2) and a hump (4) extending in a circumferential direction and formed at the outside of and in the axial direction of said ring-shaped groove, said tire comprising a toe portion (13) and a hump groove (14) which are fitted to aforesaid ring-shaped groove (3) and hump (4).

EP 0 334 955 A1

WHEEL RIM AND ASSEMBLY OF WHEEL RIM AND TYRE

The present invention relates to a rim usable for both a safety tyre and an ordinary tyre and an assembly of the rim and a safety tyre. More particularly, it provides an assembly of a wheel rim and a tyre which allows safe running free from the danger of the bead of the tyre coming off the rim even when the inner pressure of the tyre is lost and the vehicle is cornering sharply.

In an assembly of a tyre and a wheel rim, the tyre bead portion is conventionally held to the bead seat by virtue of the pressure of the inflation pressure of the tyre and the frictional force between the bead seat and the rubber of the bottom portion of the tyre bead. Thus, if inner pressure of the tyre is lowered, this holding force is reduced. If the vehicle steers sharply with such lowered inflation pressure caused by, for example a puncture, the tyre bead can come off the bead seat due to the transverse force generated by the steering forces. Usually wheel rims are provided with a well for mounting a tyre and this allows great danger of a serious accident when the bead portion of the tyre drops into the well and thereby allows the tyre to come completely off the rim. The mechanism of the bead portion of a tyre coming off the rim can be explained as follows.

The force in the transverse direction caused when a vehicle is cornering moves the tread portion in the transverse or axial direction relative to the wheel rim and produces deformation of the sidewalls of the tyre. This deformation produces forces which are transmitted from the sidewall and tyre carcass to the bead portions. As a result the ground contacting forces in the direction of the rotating axis of the tyre (hereinunder referred to as "axial direction") generate turning moment around the circumference of the bead.

At this time, if the inner pressure of the tyre

ie. inflation pressure is low, the turning moment lifts the heel of the bead portion and the frictional force between the bottom portion of the bead and the bead seat, which is the bead holding force, is reduced. As a result, the bead moves on the tapered bead base axially inwardly which reduces the tension of the bead core. The bead holding force is therefore rapidly lost, so that the bead moves further and drops into the well. To solve this problem it has been proposed to use a rim having no well or to use a rim provided with a hump adjacent to the bead toe so as to prevent the bead portion from moving inwardly in the axial direction. It has also been proposed to use an assembly of a tyre and a wheel rim having a hump provided in the bead seat and an annular groove provided at the bottom of the bead portion of the tyre so as to engage with the hump (Japanese Patent Laid-Open No. 13802/1974). Another proposal provides an assembly of a tyre and a rim having an annular groove provided axially inside the bead seat and a projection provided on the bead toe so as to engage the annular groove (Japanese Patent Publication No. 15007/1982).

Among these only the assembly disclosed in the Japanese Patent Publication No. 15007/1982 has an excellent effect as a bead holding mechanism.

Such an assembly, however, has a special configuration in the wheel rim at the point at which a normal tyre comes into contact with the bead seat of the wheel rim and the configuration at that point is the groove. It is therefore impossible to use safely a conventional tyre on the wheel rim and if a conventional tyre is used by mistake, there is a problem in terms of safety.

Accordingly, it is an object of the present invention to provide a wheel rim and an assembly of a wheel rim and a tyre which is capable of maintaining the bead portion holding mechanism of a tyre when the inner pressure of the tyre is lowered but the wheel rim is also capable of safely carrying a conventional tyre.

According to one aspect of the present invention

a wheel rim is provided including a circumferentially extending annular groove provided axially outside a tyre fitting well and a circumferentially extending hump provided axially outside said annular groove and adjacent to the bead seat.

Preferably the bead seat is tapered with respect to the axial direction. The diameter Da at the top of the hump, the diameter Db at the bottom of the annular groove, and the diameter Dc at the top of an inner protrusion, and the diameter D of the bead seat may be related by the following formuli

$-3.0\text{mm} \leqslant D-Da \leqslant +5.0\text{mm}$

$+2.0\text{mm} \leqslant D-Db \leqslant +20\text{mm}$

$0\text{mm} < D-Dc < +5.0\text{mm}$

Another aspect of the invention provides a tyre wheel rim assembly comprising a wheel rim as described as above and a tyre having a projecting toe portion which extends axially and radially inwardly of the bead reinforcement core and the bead includes between the toe portion and the bead seat engaging region an annular hump receiving groove shaped so that the tyre may fit correctly to the wheel rim.

Further aspects of the present invention will become apparent from the following description of some embodiments in conjunction with the attached diagrammatic drawings in which:-

Fig.1. is a part cross sectional view of a wheel rim according to the present invention

Fog.2 is a part cross sectional view of an assembly of a wheel rim and a tyre according to the present invention,

Fig.3. shows another example of a wheel rim section

Fig.4. is a part cross sectional view an assembly of a wheel rim according to the present invention with a conventional tyre mounted

thereon; and

Fig.5. is a cross sectional view of a tyre and wheel rim according to the present invention.

In Fig.1, a wheel rim 1 is provided with a well 2 for mounting a tyre. An annular groove 3 extending in the circumferential direction is provided axially outside the well and an inner protrusion 7. A hump 4, extending in the circumferential direction of a tyre, is formed axially outside the annular groove 3 and axially outside the hump 4, a bead seat 5 and a rim flange 6 are provided.

It is quite common to facilitate the assembly of a tyre on a wheel rim by tapering the bead seat 5 at a predetermined angle and with respect to the axial direction M. The angle α is preferably in the range of 2 to 10 degrees. If it is less than 2 degrees, it is difficult to mount a tyre on the wheel rim, while if it exceeds 10 degrees the bead holding force is lowered when the tyre is used.

The diameter Da, Db, Dc of the wheel rim surface at the top 4e of the hump, the bottom 3e of the annular groove, and the top 7e of the inner protrusion, respectively, and the diameter D of the bead seat preferably have the following relationships:

$-3.0\text{mm} \leqq D - Da \leqq + 5.0\text{mm}$

$+2.0\text{ mm} \leqq D - Db \leqq + 20\text{ mm}$

$0\text{ mm} \leqq D - Dc \leqq + 5.0\text{mm}$

If $D - Da > + 5.0\text{mm}$, $D - Db < +2.0\text{mm}$ or $D - Dc > 5.0\text{mm}$, it is difficult to obtain an effective bead holding mechanism and if $D - Da \leqq -3.0\text{mm}$ or $D - Dc < 0\text{mm}$, the operation of mounting a tyre on the wheel rim is too difficult. If $D - Db < +20\text{mm}$, it is difficult to produce a wheel rim having a adequate durability.

The diameter D of the bead seat here means the diameter of the wheel rim at the seat end H is the intersecting point of the extensions of the

bead seat 5 and the inner surface of the flange 6.

It is further possible to facilitate the mounting of a tyre on the wheel rim by setting the diameter Da, Db and Dc of the rim at the respective points so as to have the relationship of Da > Dc > Db.

Fig.3 shows an alternative example of the present invention. A bead seat 5a has a reverse taper at an angle of -B degrees respect to the axial direction, and a circumferential continuous hump 4a is provided at the inner end of the bead seat 5a without any particular protrusion. The angle -B is preferably in the range of -10 degrees to 2 degrees. If it is more than -2 degrees, it is difficult to obtain the necessary holding force, while if it is under -10 degrees,. the force applied to the flange portion becomes so large as to necessitate a special configuration for reinforcing the flange portion.

In Fig.2, the bead of the tyre is shown provided with a non stretching core 12, a projecting toe portion 13 formed axially inside of the bead core 12 extending inwardly in the radial direction, and a hump receiving groove 14 formed axially outside the toe portion 13. On assembly to the wheel rim the toe portion13 and the groove 14 engage with the annular groove 3 and the hump 4, respectively, of the wheel rim, whereby it prevents the bead portion from being moved inwardly in the axial direction by a force in the transverse direction caused during cornering of the vehicle when the inner pressure of the tyre is low.

It is necessary to set the configuration and the dimensions of the toe 13 and the configuration and the dimensions of the hump groove 14 in correspondence with the configuration and the dimensions of the annual groove 3 and the hump 4, respectively. It goes without saying that a bead apex 15 and a bead reinforcing chafer 16 are applicable to the bead portion in accordance with the purpose as in a conventional tyre. The rubber of the toe portion is preferably a

comparatively hard rubber having a hardness of, for example, 70 degrees to 95 degrees JIS-A. It is further possible to form the chafer 16 in such a manner as to envelope the toe portion 13.

It is possible to enhance the bead portion holding force of the assembly according to the present invention by ensuring the following relationships between the axial distance W3 from the heel end J of the tyre 11 to the bottom 14e of the hump groove 14 and the axial distance W4 from the heel end J to the end N of the toe portion 13, and between the axial distance W1 from the base end H of the bead seat to the top 4e and the axial distance W2 from the bead seat end H to the bottom 3e of the annular groove 3, respectively.

$$0.5 \leqslant W3/W1 \leqslant 1.2$$

$$0.7 \leqslant W4/W2 \leqslant 1.2$$

Fig.4 shows the wheel rim according to the present invention with a conventional tyre fitted. The width W5 of the bead seat is chosen to match the dimension of a rim which is at present standardised for conventional tyres and so the wheel rim according to the present invention is advantageous in that although it adopts the above described special structure for its own special tyre it is, applicable also to a tyre having a conventional bead shape and structure.

Fig.5 shows a sectional view of an assembly according to the present invention, in which the above-described special structure is adopted to the bead portions on both sides of the tyre. Needless to say, it is possible to adopt the special structure only to one bead.

The present invention is applicable to tyres and wheels for various vehicles such as passenger cars, motor-bikes, tricycles, ATVs, trucks and buses.

By way of example the following examples are suitable for applications of the present invention to the tyres and wheel rims for passenger cars, motor-bikes, and ATVs are shown

dimensionally in Table 1.

Table 1

		Example 1 Passenger Car (1)	Example 2 Passenger Car (2)	Example 3 Motorbike	Example 4 ATV
Wheel Rim	Size	6.5 × 15	6 ×15	4.00 × 17	9 × 9.0
	D	380.2 mm	380.2 mm	433.8 mm	227.8 mm
	Da	379.2 mm	379.2 mm	433.12 mm	229.4 mm
	Db	368.2 mm	370.2 mm	423.8 mm	215.8 mm
	Dc	376.2 mm	377.2 mm	429.8 mm	223.8 mm
	α	5°	5°	5°	5°
	W1	22.0 mm	22.0 mm	16.0 mm	15.0 mm
	W2	32.0 mm	31.5 mm	22.0 mm	25.0 mm
Tire	Size	205/65R15	215 SR15	150/70-17	25 × 12.00-9
	W3	17 mm	18.5 mm	15.5 mm	15 mm
	W4	27.5 mm	28.5 mm	21.5 mm	27 mm

The various tyres and wheel rims were produced according to the specifications shown in Table 1, and indoor tests and running tests were carried out, thereby confirming the effect of the present invention.

Table 2 shows examples of the present invention and a comparative example of conventional tyres and wheel rims for a passenger car. Example 1-1 is an assembly of a wheel rim and a tyre of the present invention, example 1-2 an assembly of a wheel rim of the present invention and a conventional tyre, and Comparative example 1 an assembly of conventional wheel rim and tyre, the tyre being 205.65R15 and the rim 6.5 in 15 in in size.

The bead dislodgement forces of these three assemblies were measured by an indoor testing machine where bead dislodgement was caused by applying a force in the transverse direction to the tread portion under three inflation conditions where the inner pressure was 0 kg.cm , 1.0 kg/cm and 2.0 kg.cm , respectively.

Table 2

[Tires and Wheel Rims for a Passenger Car (1)]

		Example 1-1	Example 1-2	Comparative Example 1
Wheel Rim	Size	6.5 × 15	6.5 ×15	61/2 JJ × 15
	D	380.2 mm	380.2 mm	Conventional Rim
	Da	379.2 mm	379.2 mm	
	Db	368.2 mm	368.2 mm	
	Dc	376.2 mm	376.2 mm	
	α	5°	5°	
	W1	22.0 mm	22.0 mm	
	W2	32.0 mm	32.0 mm	
Tire	Size	205/65R15	205/65R15	205/65R15
	W3	17 mm	Conventional Tire	Conventional Tire
	W4	27.5 mm		
Indoor Test	*B.D.F / ** I.P.			
	0	680	380	200
	1.0	1240	900	810
	2.0	2235	1770	1500

* B.D.F. ... Bead Dislodgement Force (kg)

** I.P. ... Inner Pressure (kg/cm^2)

As can be seen, example 1-1 of the present invention exhibited an excellent bead dislodgement capacity. In the case of mounting a conventional tyre on the wheel rim according to the present invention a slight effect was also exhibited on the bead dislodgement capacity, as it clear from the results of the example 1-2 and the assembly was found to be practically usable without a problem.

Table 3 shows further examples of the present invention and a comparative example of other tyres and wheel rims for a passenger car. Examples 2-1 and 2-2 are assemblies of wheel rims and tyres according to the present invention, example 2-3 an assembly of a wheel rim of the present invention and a conventional tyre, and comparative example 2 and assembly of a conventional wheel rim and a conventional tyre, the tyre being 215 SR15 and the rim 6 in x 15 in. in size. The tyres and wheel rims in the examples were produced specifically for a car with four wheel drive.

Table 3

[Tires and Wheel Rims for a Passenger Car (2)]

		Example 2-1	Example 2-2	Example 2-3	Comparative Example 2
Wheel Rim	Size	6 × 15	6 ×15	6 × 15	6 JJ × 15
	D	380.2 mm	380.2 mm	380.2 mm	
	Da	379.2 mm	379.2 mm	379.2 mm	Conventional Rim
	Db	370.2 mm	370.2 mm	370.2 mm	
	Dc	377.2 mm	377.2 mm	377.2 mm	
	α	5°	5°	5°	
	W1	22.0 mm	22.0 mm	22.0 mm	
	W2	31.5	31.5 mm	31.5 mm	
Tire	Size	215/SR15	215/SR15	215/SR15	215/SR15
	W3	18.5 mm	18.5 mm	Conventional Tire	Conventional Tire
	W4	28.5 mm	28.5 mm		
	Hardness of Toe Portion	78°	64°		
Indoor Test	*B.D.F. ** I.P				
	0	690	650	340	200
	1.0	1730	1320	930	840
	2.0	1800	1800	1500	1270

*B.D.F. ... Bead Dislodgement Force (kg)

** I.P ... Inner Pressure (kg/cm^2)

These examples show that the present invention has greatly advantageous effects on the bead dislodgement capacity as in the examples in table 2. In the case of mounting a conventional tyre on the wheel rim according to the present invention a slight effect was also exhibited on the bead dislodgement capacity, and the assembly was found to be practically usable without a problem. It was also found from examples 2-1 and 2-2 that a tyre having a harder toe portion exhibits a higher effect, specifically, when the inner pressure is low. The effect of the present invention were further confirmed by running tests. The results are shown in table 4.

Table 4

Tires and Wheel Rims for a Passenger Car (1)			Tires and Wheel Rims for a Passenger Car (2)			
	Ex. 1-1	Comp. Ex. 1			Ex. 2-1	Comp. Ex. 2
*I.P (kg/cm^2)	0.0	0.8	Turning Speed		** TN/D	** TN/D
				30 km/h	2/NO	2/NO
				35 km/h	2/NO	2/NO
				40 km/h	10/NO	3/YES

*. I.P. ... Inner Pressure When Bead Dislodgement Occurred

**TN ... Number of TESTS

D ... Bead Dislodgement Occurred?

In the left column of table 4 the results of the tests of the tyres and wheel rims for a passenger car of example 1-1 and comparative example 1 in table 2 are shown. The respective assemblies of the tyres and wheel rims were mounted on the right front wheel of a Japanese passenger car having a displacement of 3 litres. The inner pressure was gradually reduced in a J turn test in which the wheel was sharply turned to the left to give a circle of 25m radius at a speed of 60 km/h, thereby causing bead dislodgement. In these tests, bead dislodgement resulted in the assembly of comparative example 1 when the inner pressure was 0.8kg.cm , while it was not until the inner pressure was 0 kg/cm , in other words, until the tyre was completely punctured that bead dislodgement occurred in the assembly of example 1-1.

In the right column of table 4 the results of the tests of other tyres and wheel rims for a passenger car of example 2-1 and comparative example 2 in table 3 are shown. After the respective tyres and wheel rims were completely assembled in inflated the inner pressure was reduced to 0 kg/cm . The respective assemblies were mounted on the right front wheel of a Japanese car with four wheel drive having a displacement of 4 litres. Whether or not bead dislodgement occurred was examined in a J turn test in which the wheel was sharply turned left to give a 30m radius at speeds of 30 km/h, 35 km/h and 40 km/h, respectively. In these tests, bead dislodgement was caused in the assembly of comparative example 2 when the wheel had been tested by the J turn test 3 rimes at a speed of 40 km/h, while no bead dislodgement was caused in the assembly of example 2-1 even after the wheel had been tested 10 times at a speed of 40 km/h.

It goes without saying that application of the present invention does not impair other performances of a tyre. As an example, the results of the comparison between the performance of a tyre in examples 1-01 and comparative example 1 are shown in table 5.

Table 5

	Example 1-1	Comparative Example 1
Rolling Resistance Index	(100)	(100)
Cornering Power kg/deg (Index)	151 (101)	149 (100)
Cornering Force @ 10° kg (Index)	433 (100)	433 (100)
Self Aligning Torque Power kg·m/deg (Index)	4.5 (102)	4.4 (100)
Repulsive Power Index at the Time of GOING over a Bump (Index)	(99)	(100)
Vertical Stiffness (Index)	21.2 (101)	21.0 (100)
Lateral Stiffness (Index)	15.9 (99)	16.0 (100)
Rolling Radius mm (Index)	311 (100)	311 (100)

Table 5 shows the values obtained by measuring the respective assemblies of tyres and wheel rims in the indoor tests carried out under the conditions that the inflation pressure was 2.0 kg/cm and the vertical load was 400 kg.

The rolling resistance index is indicated by the index of the value of the rolling resistance at a speed of 80 km/h, the cornering power by the value of the cornering force at a slip angle of 1 degree, the cornering force at 10 degrees by the value of the cornering force at a slip angle of 10 degrees, and the self aligning torque power of the value of the self aligning torque at a slip angle of 1 degree respectively. The repulsive power index at the time of going over a bump is indicated by the index of the average value of the repulsive power inn the vertical direction and in the forward and backward direction produced when going over a square far of 10 mm x 10 mm which is attached to a drum at a speed of 20 to 100 km/h. The index in each performance is the value taken on the assumption that the value in comparative example 1 is 100.

No degradation caused by the application of the present invention was found in any performance of a tyre.

An assembly of a wheel rim and a tyre according to the present invention can be produced by a conventional method, and be mounted on a vehicle in the same way as in a conventional tyre and wheel rim., Furthermore, an assembly of the present invention enables safe running free from danger of dislodgement of the bead portion even when the inner pressure of the tyre is lowered and when the vehicle is cornering sharply.

CLAIMS

1. A wheel rim characterised by a circumferentially extending annular groove (3) provided axially outside a well (2) and a circumferentially extending hump (4) provided axially outside said annular groove (3) and adjacent to the bead seat (5).

2. A wheel rim according to claim 1, characterised in that the bead seat (5) is tapered at a predetermined angle (α) with respect to the axial direction (M).

3. A wheel rim according to either of claims 1 and 2, characterised in that the diameter Da at the top (4e) of said hump (4), the diameter Db at the bottom (3e) of said annular groove (3), and the diameter Dc at the top (7e) of an inner protrusion (7), respectively, and the diameter D of said bead seat have the following relationships:

$$-3.0 \text{ mm} \leqslant D - Da \leqslant +5.0 \text{ mm}$$

$$+2.0 \text{ mm} \leqslant D - Db \leqslant +20 \text{ mm}$$

$$0 \text{ mm} \leqslant D - Dc \leqslant +5.0 \text{ mm}$$

4. A wheel rim according to any one of claims 1, 2 or 3 characterised in that the diameters Da, Db, Dc at said respective points have the following relationships:

$$Da > Dc > Db$$

5. A tyre and wheel rim assembly comprising a tubeless tyre (11) having a pair of bead portions and a wheel rim (10) having a well for mounting the tyre, characterised in that at least one of said bead portions is provided with a toe (13) formed axially inside a non stretching bead core (12) in such a manner as to extend inwardly in the radial direction and an annular hump receiving groove (14) formed between said toe portion (13) and a heel

portion, and in that said wheel rim (10) is provided with an annular groove (3) for receiving the end (n) of said toe portion (13) and a hump (4) which is formed axially outside said annular groove in such a manner as to be engaged with said hump receiving groove (14).

6. An assembly of a wheel rim and a tyre according to claim 5, characterised in that the axial distance (w3) between the heel end (J) of said tyre (11) and the bottom (14e) of the hump receiving groove (14) is in the range of 50 to 150% of the axial distance (w1) between the bead seat end (h) of said wheel rim (10) and said apex (4e) of said hump (4), and the axial distance (w4) between said heel end (J) of said tyre (11) and said end (N) of said toe portion (13) is in the range of 70 to 150% of the axial distance (W2) between said bead seat end (H) of said wheel rim (10) and said bottom (3e) of said annular groove (3).

FIG. 1

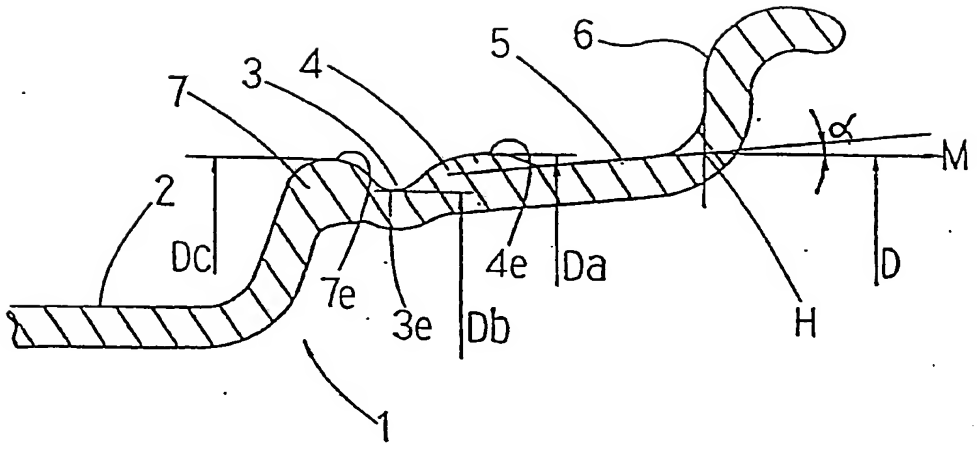


FIG. 2

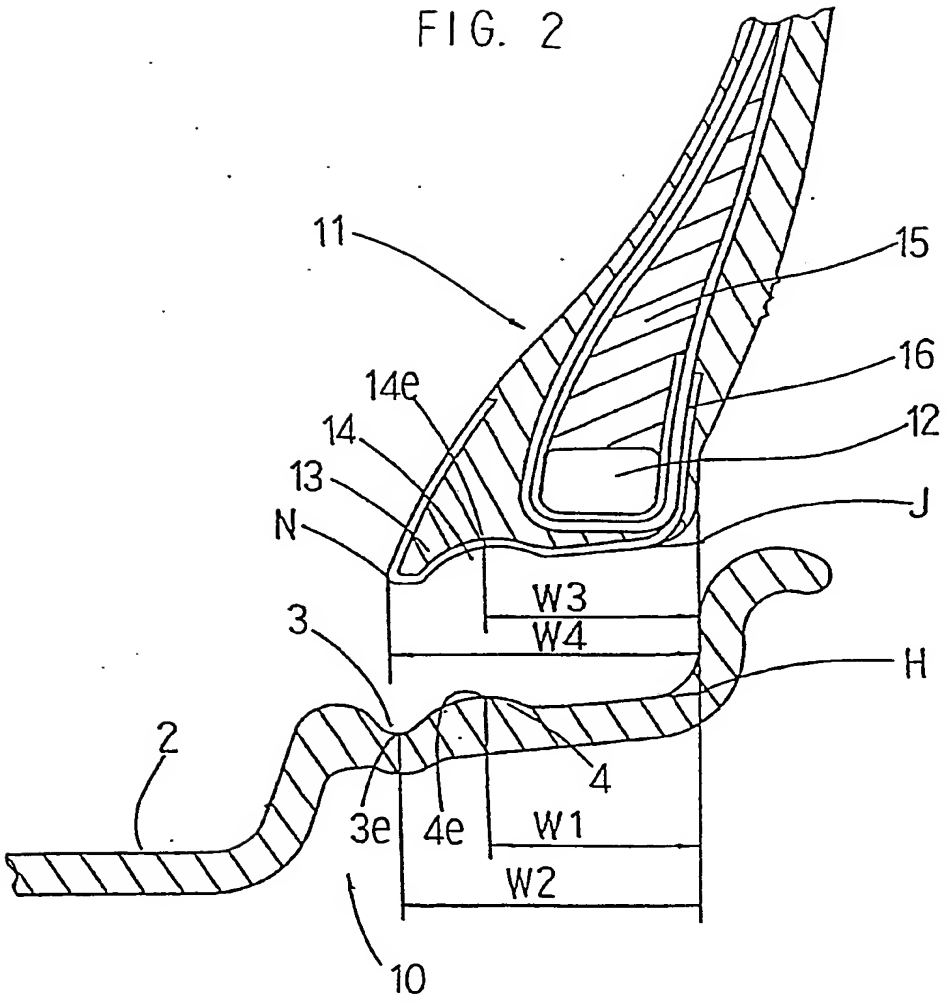


FIG. 3

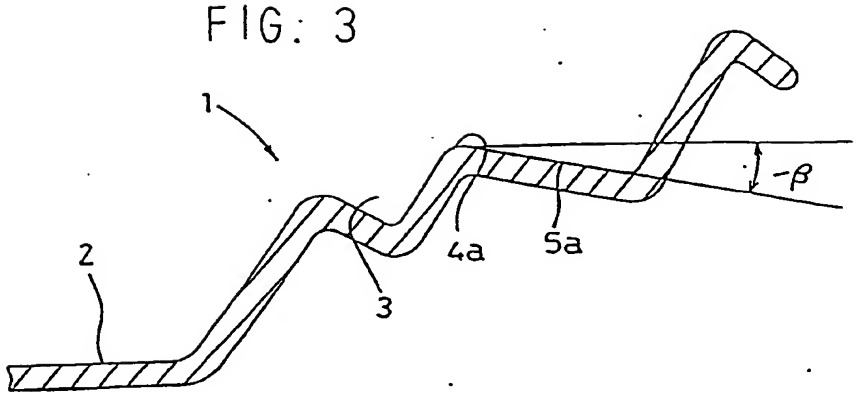


FIG. 4

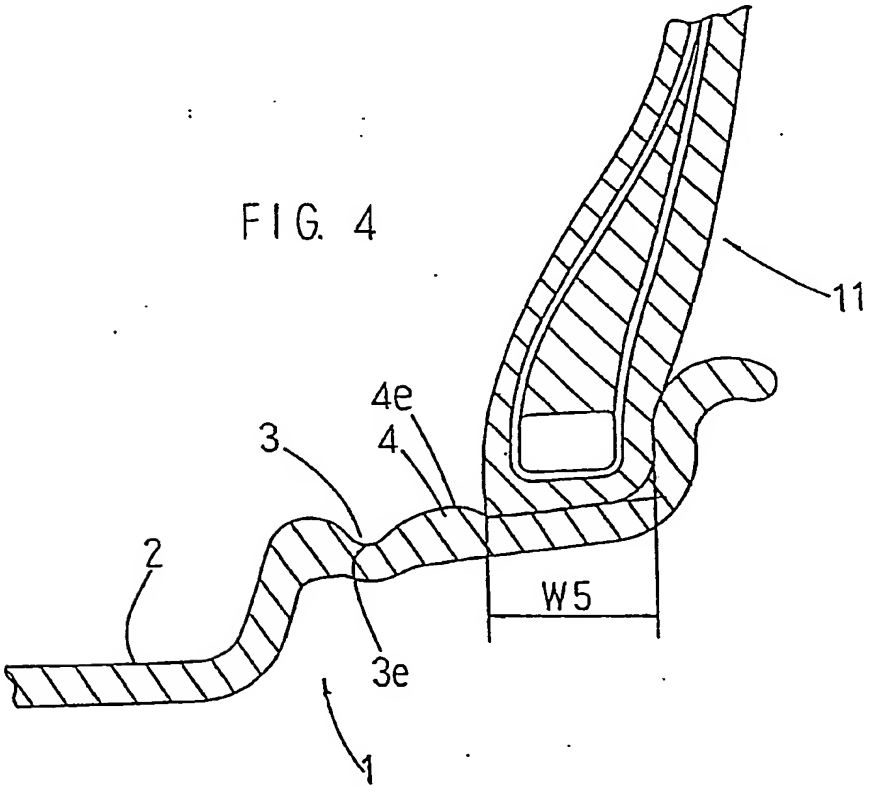
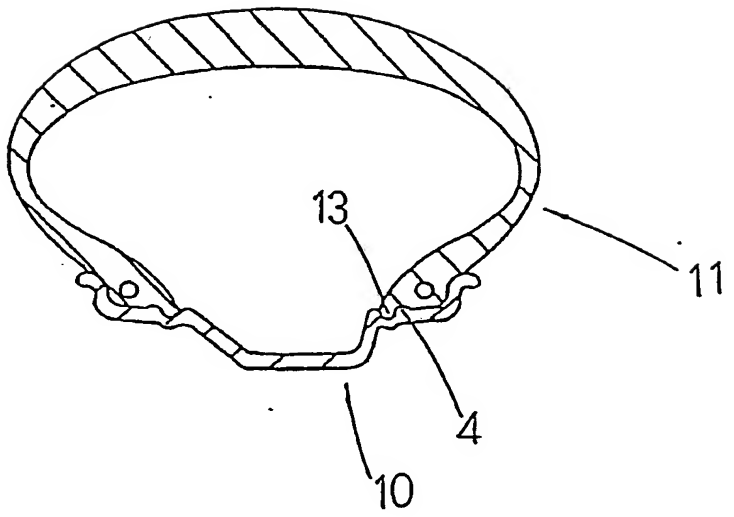


FIG. 5



INTERNATIONAL SEARCH REPORT

0334955

International Application No PCT/JP87/00299

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl[4] B60B21/10, B60C15/02

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC	B60B21/00-21/10, B60C15/00-15/024

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

Jitsuyo Shinan Koho 1926 - 1987
Kokai Jitsuyo Shinan Koho 1971 - 1987

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category *	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
A	JP, A, 54-100004 (Dunlop Limited) 7 August 1979 (07. 08. 79) Figs. 1, 3 to 4 & BE, A1, 872922 & FI, A, 783967 & SE, A, 7813222 & NL, A, 7812400 & DE, A1, 2855686 & AU, A1, 4278278 & GB, A, 2011324 & FR, A1, 2412423 & US, A, 4209051 & GB, B2, 2011324 & FR, B1, 2412423 & FI, B, 65036 & FI, C, 65036	1-2, 5-6
A	JP, B2, 57-15007 (Dunlop Limited) 27 March 1982 (27. 03. 82) & LU, A, 77478 & BE, A1, 855335 & AR, A1, 211185 & FI, A, 771713 & NL, A, 7706129 & NO, A, 771880 & DE, A1, 2724996 & PL, O, 198644 & BR, A, 7703647 & DD, C, 130462 & FR, A1, 2378643 & AU, A1, 2578277 & ES, A1, 459482 & NZ, A, 184265 & GR, A, 63227 & AT, B, 360353	1-6

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
May 26, 1987 (26. 05. 87)	June 8, 1987 (08. 06. 87)
International Searching Authority [1]	**Signature of Authorized Officer [20]**
Japanese Patent Office	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

& DE, B2, 2724996 & AT, A, 396377
& CA, A2, 1081282 & ES, U, 244318
& DE, C3, 2724996 & FR, B1, 2378643
& ES, Y, 244318 & AT, B, 360353
& ES, Y1, 244318 & CA, A1, 1094436
& ES, U, 250075 & FI, A, 810764
& FI, B, 59222 & NO, B, 144516
& MX, A, 143684 & FI, C, 59222
& HU, P, 177085 & NO, C, 144516
& IN, A, 149325 & IN, A, 149326
& IN, A, 149327 & ES, Y, 250075
& CH, A, 626836 & ES, Y1, 250075

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers_____, because they relate to subject matter [11] not required to be searched by this Authority, namely:

2. ☐ Claim numbers_____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [12], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [13]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

	& NL, B, 172934 & NL, C, 172934 & FI, B, 66143 & FI, C, 66143	
A	JP, A, 58-145508 (Sumitomo Rubber Industries, Ltd.) 30 August 1983 (30. 08. 83) (Family: none)	1-6
A	JP, A, 61-16102 (Sumitomo Rubber Industries, Ltd.) 24 January 1986 (24. 01. 86) (Family: none)	1-6

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE[10]

This International search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers_____, because they relate to subject matter[12] not required to be searched by this Authority, namely:

2. ☐ Claim numbers_____, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out[13], specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING[11]

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.
2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:
3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:
4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.